A First Course on Kinetics and Reaction Engineering

Unit 28. Lesson Plan

Before Class

- Provide the slides to the students and tell them to bring a printed copy of the slides to class

During Class

- Introduce today's topic and where it fits in the course
  - Slides 1 and 2
- Review of Unit 28 (5 minutes)
  - Slide 3: go over the key concepts on the slides
  - Slide 4: ask whether the students have any questions from their pre-class preparation and answer them
- Learning Activity 28 (~40 minutes)
  - Slide 5: Read through the problem and then start a discussion on how to begin.
    - Lead the discussion to the conclusion that a qualitative analysis is a good way to start
  - Slide 6: Go over the bullet items and then tell the class to do the qualitative analysis; give them 5 to 10 minutes; circulate and answer questions as they work
    - When most appear finished, ask someone to summarize
  - Slide 7: Tell them that the qualitative rate behavior can now be used to qualitatively compare the two flow reactors and give them 5 to 10 minutes to do so
  - Slide 8: Talk them through the reactor comparison
    - Emphasize that a qualitative analysis can't reveal the exact conversion where the CSTR volume becomes larger than the PFR, for that a quantitative analysis is needed
    - Go over the last bullet item, noting that if the rate is very low at the initial conditions, neither the batch nor the pfr will be able to operate adiabatically, they'll need pre-heating and that will add costs. Ask how that can be checked and lead the discussion to the conclusion that they can easily calculate the initial rate to see
  - Slide 9: Ask whether the rate seems large enough for adiabatic operation and then show the slide
    - Note that they can also use the initial rate to make an estimate of the batch process times, then go over the remaining items
  - Slide 10: Reiterate that a quantitative comparison of the CSTR and PFR will be needed, then suggest the process given.
    - Divide the class in half and assign the CSTR analysis to one half and the PFR analysis to the other
  - Slide 11: Remind them of the process used in the analysis of reactors over the past several units using this slide, then tell them to perform their analysis
    - Ideally, have them write the code and generate the necessary plot

  - Slide 12: When most have the problem set up, use this slide to review the process they need to implement numerically
  - Slide 13: If time and facilities allow, have the two groups display their plots (or even combine them into a single plot), otherwise show them this plot
    - Point out that the qualitative analysis was correct
- Summary
  - Slide 14: Put the material covered in this class into the overall context of the course.

After Class

- If the students were told to complete the activity as homework, give them the due date

Variations

- There isn't much "meat" in this Unit; both qualitative and quantitative analysis of the ideal reactors was practiced in earlier units. The in-class activity is designed to serve as a review of solving steady state CSTR and PFR problems, more than an exercise in qualitative comparison of reactors. The quantitative solution could be eliminated and replaced a second qualitative analysis problem or perhaps one that incorporates cost data.